North Carolina Department of Public Instruction
INSTRUCTIONAL SUPPORT TOOLS
FOR ACHIEVING NEW STANDARDS

7th Grade Mathematics ● Unpacked Content

For the new Common Core standards that will be effective in all North Carolina schools in the 2012-13 school year.

This document is designed to help North Carolina educators teach the Common Core (Standard Course of Study). NCDPI staff are continually updating and improving these tools to better serve teachers.

What is the purpose of this document?
To increase student achievement by ensuring educators understand specifically what the new standards mean a student must know, understand and be able to do.

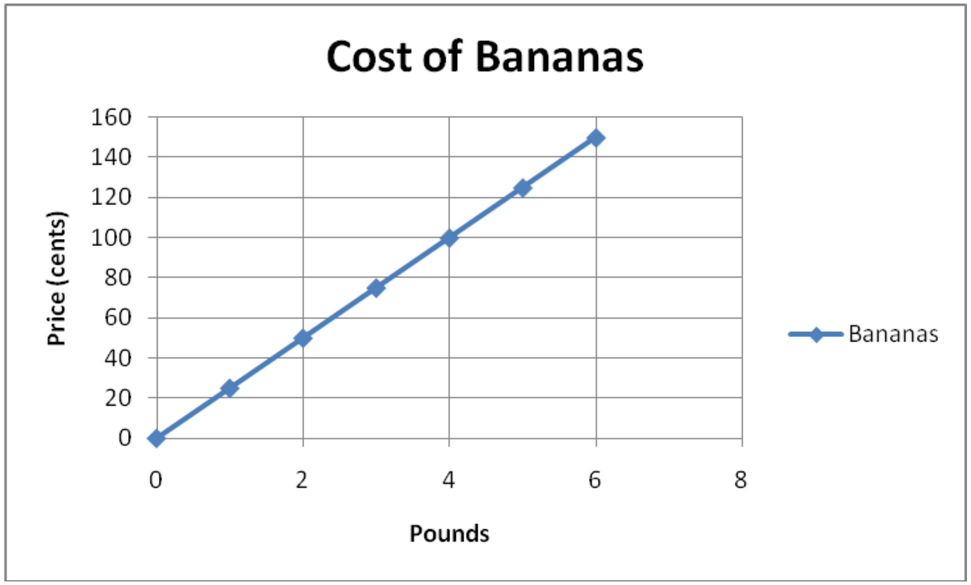
What is in the document?
Descriptions of what each standard means a student will know, understand and be able to do. The "unpacking" of the standards done in this document is an effort to answer a simple question "What does this standard mean that a student must know and be able to do?" and to ensure the description is helpful, specific and comprehensive for educators.

How do I send Feedback?
We intend the explanations and examples in this document to be helpful and specific. That said, we believe that as this document is used, teachers and educators will find ways in which the unpacking can be improved and made ever more useful. Please send feedback to us at feedback@dpi.state.nc.us and we will use your input to refine our unpacking of the standards. Thank You!

Just want the standards alone?
You can find the standards alone at www.corestandards.org .

Ratios and Proportional Relationships	**7.RP**
Common Core Cluster	
Analyze proportional relationships and use them to solve real-world and mathematical problems.	
Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
7.RP.1 Compute unit rates associated with ratios of fractions, including ratios of lengths, areas and other quantities measured in like or different units. *For example, if a person walks 1/2 mile in each 1/4 hour, compute the unit rate as the complex fraction 1/2/1/4 miles per hour, equivalently 2 miles per hour.*	**7.RP.1** Students continue to work with unit rates from 6th grade; however, the comparison now includes fractions compared to fractions. For example, if $\frac{1}{2}$ gallon of paint covers $\frac{1}{6}$ of a wall, then the amount of paint needed for the entire wall can be computed by $\frac{1}{2}$ gal / $\frac{1}{6}$ wall. This calculation gives 3 gallons. This standard requires only the use of ratios as fractions. Fractions may be proper or improper.
7.RP.2 Recognize and represent proportional relationships between quantities. a. Decide whether two quantities are in a proportional relationship, e.g., by testing for equivalent ratios in a table or graphing on a coordinate plane and observing whether the graph is a straight line through the origin. b. Identify the constant of proportionality (unit rate) in tables, graphs, equations, diagrams, and verbal descriptions of proportional relationships. c. Represent proportional relationships by equations. *For example, if total cost t is proportional to the number n of items purchased at a constant price p, the relationship between the total*	**7.RP.2** Students' understanding of the multiplicative reasoning used with proportions continues from 6th grade. Students determine if two quantities are in a proportional relationship from a table. For example, the table below gives the price for different number of books. Do the numbers in the table represent a proportional relationship? Students can examine the numbers to see that 1 book at 3 dollars is equivalent to 4 books for 12 dollars since both sides of the tables can be multiplied by 4. However, the 7 and 18 are not proportional since 1 book times 7 and 3 dollars times 7 will not give 7 books for 18 dollars. Seven books for $18 is not proportional to the other amounts in the table; therefore, there is not a constant of proportionality. **Number of Books** / **Price**: 1 / 3; 3 / 9; 4 / 12; 7 / 18 Students graph relationships to determine if two quantities are in a proportional relationship and interpret the ordered pairs. If the amounts from the table above are graphed (number of books, price), the pairs (1, 3), (3, 9), and (4, 12) will form a straight line through the origin (0 books cost 0 dollars), indicating that these pairs are in a proportional relationship. The ordered pair (4, 12) means that 4 books cost $12. However, the ordered pair (7, 18) would not be on the line, indicating that it is not proportional to the other pairs. The ordered pair (1, 3) indicates that 1 book is $3, which is the unit rate. The *y*-coordinate when x = 1 will be the

Number of Books	Price
1	3
3	9
4	12
7	18

cost and the number of items can be expressed as t = pn. d. Explain what a point (x, y) on the graph of a proportional relationship means in terms of the situation, with special attention to the points (0, 0) and (1, r) where r is the unit rate.	unit rate. The constant of proportionality is the unit rate. Students identify this amount from tables (see example above), graphs, equations and verbal descriptions of proportional relationships. The graph below represents the price of the bananas at one store. What is the constant of proportionality? From the graph, it can be determined that 4 pounds of bananas is \$1.00; therefore, 1 pound of bananas is \$0.25, which is the constant of proportionality for the graph. Note: Any point on the graph will yield this constant of proportionality.  The cost of bananas at another store can be determined by the equation: $P = \$0.35n$, where P is the price and n is the number of pounds. What is the constant of proportionality (unit rate)? Students write equations from context and identify the coefficient as the unit rate which is also the constant of proportionality. **Note:** This standard focuses on the representations of proportions. Solving proportions is addressed in **7.SP.3**.

Ratios and Proportional Relationships 7.RP

Common Core Cluster

Analyze proportional relationships and use them to solve real-world and mathematical problems.

Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
7.RP.3 Use proportional relationships to solve multistep ratio and percent problems. *Examples: simple interest, tax, markups and markdowns, gratuities and commissions, fees, percent increase and decrease, percent error*	**7.RP.3** In 6th grade, students used ratio tables and unit rates to solve problems. Students expand their understanding of proportional reasoning to solve problems that are easier to solve with cross-multiplication. Students understand the mathematical foundation for cross-multiplication. For example, a recipe calls for $\frac{3}{4}$ teaspoon of butter for every 2 cups of milk. If you increase the recipe to use 3 cups of milk, how many teaspoons of butter are needed? Using these numbers to find the unit rate may not be the most efficient method. Students can set up the following proportion to show the relationship between butter and milk. $$\frac{\frac{3}{4}}{2} = \frac{x}{3}$$ The use of proportional relationships is also extended to solve percent problems involving tax, markups and markdowns simple interest (I = prt, I = interest, p = principal, r = rate, and t = time), gratuities and commissions, fees, percent increase and decrease, and percent error. For example, Games Unlimited buys video games for \$10. The store increases the price 300%? What is the price of the video game? Using proportional reasoning, if \$10 is 100% then what amount would be 300%? Since 300% is 3 times 100%, \$30 would be \$10 times 3. Thirty dollars represents the amount of increase from \$10 so the new price of the video game would be \$40. Finding the percent error is the process of expressing the size of the error (or deviation) between two measurements. To calculate the percent error, students determine the absolute deviation (positive difference) between an actual measurement and the accepted value and then divide by the accepted value. Multiplying by 100 will give the percent error. $$\%\ \text{error} = \frac{\lvert \text{your result} - \text{accepted value} \rvert}{\text{accepted value}} \times 100\ \%$$ For example, you need to purchase a countertop for your kitchen. You measured the countertop as 5 ft. The actual

	measurement is 4.5 ft. What is the percent error? $$\% \text{ error} = \frac{\lvert 5 \text{ ft.} - 4.5 \text{ ft.} \rvert}{4.5} \times 100$$ $$\% \text{ error} = \frac{0.5 \text{ ft.}}{4.5} \times 100$$ Several problem situations have been represented with this standard; however, every possible situation cannot be addressed here.

The Number System	7.NS
Common Core Cluster	
Apply and extend previous understandings of operations with fractions to add, subtract, multiply, and divide rational numbers.	
Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
7.NS.1 Apply and extend previous understandings of addition and subtraction to add and subtract rational numbers; represent addition and subtraction on a horizontal or vertical number line diagram. a. Describe situations in which opposite quantities combine to make 0. For example, a hydrogen atom has 0 charge because its two constituents are oppositely charged. b. Understand $p + q$ as the number located a distance $\|q\|$ from p, in the positive or negative direction depending on whether q is positive or negative. Show that a number and its opposite have a sum of 0 (are additive inverses). Interpret sums of rational numbers by describing real-world contexts. c. Understand subtraction of rational numbers as adding the additive inverse, $p – q = p + (–q)$. Show that the distance between two rational numbers on the number line is the absolute value of their difference, and apply this principle in real-world contexts. d. Apply properties of operations as strategies to add and subtract rational numbers.	**7.NS.1** Students add and subtract rational numbers using a number line. For example, to add -5 + 7, students would find -5 on the number line and move 7 in a positive direction (to the right). The stopping point of 2 is the sum of this expression. Students also add negative fractions and decimals and interpret solutions in given contexts.

7.NS.2 Apply and extend previous understandings of multiplication and division and of fractions to multiply and divide rational numbers. a. Understand that multiplication is extended from fractions to rational numbers by requiring that operations continue to satisfy the properties of operations, particularly the distributive property, leading to products such as (–1)(–1) = 1 and the rules for multiplying signed numbers. Interpret products of rational numbers by describing real-world contexts. b. Understand that integers can be divided, provided that the divisor is not zero, and every quotient of integers (with non-zero divisor) is a rational number. If *p* and *q* are integers, then $-(p/q) = (-p)/q = p/(-q)$. Interpret quotients of rational numbers by describing real-world contexts. c. Apply properties of operations as strategies to multiply and divide rational numbers. d. Convert a rational number to a decimal using long division; know that the decimal form of a rational number terminates in 0s or eventually repeats.	**7.NS.2** Students recognize that when division of rational numbers is represented with a fraction bar, each number can have a negative sign. Using long division from elementary school, students understand the difference between terminating and repeating decimals. This understanding is foundational for work with rational and irrational numbers in 8th grade. For example, identify which fractions will terminate (the denominator of the fraction in reduced form only has factors of 2 and/or 5)

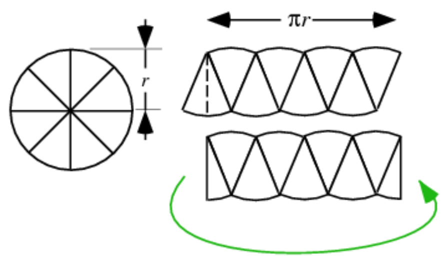
7.NS.3 Solve real-world and mathematical problems involving the four operations with rational numbers.[1] [1]Computations with rational numbers extend the rules for manipulating fractions to complex fractions.	**7.NS.3** Students use order of operations from 6th grade to write and solve problem with all rational numbers.

Expressions and Equations	**7.EE**
Common Core Cluster	
Use properties of operations to generate equivalent expressions.	
Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
7.EE.1 Apply properties of operations as strategies to add, subtract, factor, and expand linear expressions with rational coefficients.	**7.EE.1** This is a continuation of work from 6th grade using properties of operations (table 3, pg. 90) and combining like terms. Students apply properties of operations and work with rational numbers (integers and positive / negative fractions and decimals) to write equivalent expressions.
7.EE.2 Understand that rewriting an expression in different forms in a problem context can shed light on the problem and how the quantities in it are related. *For example, a + 0.05a = 1.05a means that "increase by 5%" is the same as "multiply by 1.05."*	**7.EE.2** Students understand the reason for rewriting an expression in terms of a contextual situation. For example, students understand that a 20% discount is the same as finding 80% of the cost (.80c). All varieties of a brand of cookies are \$3.50. A person buys 2 peanut butter, 3 sugar and 1 chocolate. Instead of multiplying 2 x \$3.50 to get the cost of the peanut butter cookies, 3 x \$3.50 to get the cost of the sugar cookies and 1 x \$3.50 for the chocolate cookies and then adding those totals together, student recognize that multiplying \$3.50 times 6 will give the same total.

Expressions and Equations	7.EE
Common Core Cluster	
Solve real-life and mathematical problems using numerical and algebraic expressions and equations.	
Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
7.EE.3 Solve multi-step real-life and mathematical problems posed with positive and negative rational numbers in any form (whole numbers, fractions, and decimals), using tools strategically. Apply properties of operations to calculate with numbers in any form; convert between forms as appropriate; and assess the reasonableness of answers using mental computation and estimation strategies. *For example: If a woman making $25 an hour gets a 10% raise, she will make an additional 1/10 of her salary an hour, or $2.50, for a new salary of $27.50. If you want to place a towel bar 9 3/4 inches long in the center of a door that is 27 1/2 inches wide, you will need to place the bar about 9 inches from each edge; this estimate can be used as a check on the exact computation.*	**7.EE.3** Students solve contextual problems using rational numbers. Students convert between fractions, decimals, and percents as needed to solve the problem. Students use estimation to justify the reasonableness of answers.

7.EE.4 Use variables to represent quantities in a real-world or mathematical problem, and construct simple equations and inequalities to solve problems by reasoning about the quantities. a. Solve word problems leading to equations of the form $px + q = r$ and $p(x + q) = r$, where p, q, and r are specific rational numbers. Solve equations of these forms fluently. Compare an algebraic solution to an arithmetic solution, identifying the sequence of the operations used in each approach. *For example, the perimeter of a rectangle is 54 cm. Its length is 6 cm. What is its width?*	**7.EE.4** Students solve multi-step equations and inequalities derived from word problems. Students use the arithmetic from the problem to generalize an algebraic solution
b. Solve word problems leading to inequalities of the form $px + q > r$ or $px + q < r$, where p, q, and r are specific rational numbers. Graph the solution set of the inequality and interpret it in the context of the problem. *For example: As a salesperson, you are paid $50 per week plus $3 per sale. This week you want your pay to be at least $100. Write an inequality for the number of sales you need to make, and describe the solutions.*	Students graph inequalities and make sense of the inequality in context. Inequalities may have negative coefficients. Problems can be used to find a maximum or minimum value when in context.

Geometry	**7.G**
Common Core Cluster	
Draw, construct, and describe geometrical figures and describe the relationships between them.	
Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
7.G.1 Solve problems involving scale drawings of geometric figures, including computing actual lengths and areas from a scale drawing and reproducing a scale drawing at a different scale.	**7.G.1** Students determine the dimensions of figures when given a scale and identify the impact of a scale on actual length (one-dimension) and area (two-dimensions). Students identify the scale factor given two figures. Using a given scale drawing, students reproduce the drawing at a different scale. Students understand that the lengths will change by a factor equal to the product of the magnitude of the two size transformations.
7.G.2 Draw (freehand, with ruler and protractor, and with technology) geometric shapes with given conditions. Focus on constructing triangles from three measures of angles or sides, noticing when the conditions determine a unique triangle, more than one triangle, or no triangle. **7.G.3** Describe the two-dimensional figures that result from slicing three-dimensional figures, as in plane sections of right rectangular prisms and right rectangular pyramids.	**7.G.2** Students understand the characteristics of angles that create triangles. For example, can a triangle have more than one obtuse angle? Will three sides of any length create a triangle? Students recognize that the sum of the two smaller sides must be larger than the third side. **7.G.3** Students need to describe the resulting face shape from cuts made parallel and perpendicular to the bases of right rectangular prisms and pyramids. Cuts made parallel will take the shape of the base; cuts made perpendicular will take the shape of the lateral (side) face. Cuts made at an angle through the right rectangular prism will produce a parallelogram; cuts made at an angle through the right rectangular pyramid will also produce a parallelogram.

Geometry	7.G
Common Core Cluster	
Solve real-life and mathematical problems involving angle measure, area, surface area, and volume.	
Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
7.G.4 Know the formulas for the area and circumference of a circle and use them to solve problems; give an informal derivation of the relationship between the circumference and area of a circle.	**7.G.4** Students understand the relationship between radius and diameter. Students also understand the ratio of circumference to diameter can be expressed as Pi. Building on these understandings, students generate the formulas for circumference and area. The illustration shows the relationship between the circumference and area. If a circle is cut into wedges and laid out as shown, a parallelogram results. Half of an end wedge can be moved to the other end a rectangle results. The height of the rectangle is the same as the radius of the circle. The base length is $\frac{1}{2}$ the circumference ($2\pi r$). The area of the rectangle (and therefore the circle) is found by the following calculations:  A_{rect} = Base x Height Area = ½ ($2\pi r$) x r Area = πr x r Area = πr^2 http://mathworld.wolfram.com/Circle.html Students solve problems (mathematical and real-world) including finding the area of left-over materials when circles are cut from squares and triangles or from cutting squares and triangles from circles. "Know the formula" does not mean memorization of the formula. To "know" means to have an understanding of ***why*** the formula works and how the formula relates to the measure (area and circumference) and the figure. This understanding should be for *all* students.

7.G.5 Use facts about supplementary, complementary, vertical, and adjacent angles in a multi-step problem to write and solve simple equations for an unknown angle in a figure.	**7.G.5** Students use understandings of angles to write and solve equations.
7.G.6 Solve real-world and mathematical problems involving area, volume and surface area of two- and three-dimensional objects composed of triangles, quadrilaterals, polygons, cubes, and right prisms.	**7.G.6** Students continue work from 5th and 6th grade to work with area, volume and surface area of two-dimensional and three-dimensional objects. (composite shapes) Students will not work with cylinders, as circles are not polygons. "Know the formula" does not mean memorization of the formula. To "know" means to have an understanding of ***why*** the formula works and how the formula relates to the measure (area and volume) and the figure. This understanding should be for *all* students. Surface area formulas are not the expectation with this standard. Building on work with nets in the 6th grade, students should recognize that finding the area of each face of a three-dimensional figure and adding the areas will give the surface area. No nets will be given at this level.

Statistics and Probability 7.SP

Common Core Cluster

Use random sampling to draw inferences about a population.

Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
7.SP.1 Understand that statistics can be used to gain information about a population by examining a sample of the population; generalizations about a population from a sample are valid only if the sample is representative of that population. Understand that random sampling tends to produce representative samples and support valid inferences.	**7.SP.1** Students recognize that it is difficult to gather statistics on an entire population. Instead a random sample can be representative of the total population and will generate valid results. Students use this information to draw inferences from data. A random sample must be used in conjunction with the population to get accuracy. For example, a random sample of elementary students cannot be used to give a survey about the prom.

7.SP.2 Use data from a random sample to draw inferences about a population with an unknown characteristic of interest. Generate multiple samples (or simulated samples) of the same size to gauge the variation in estimates or predictions. *For example, estimate the mean word length in a book by randomly sampling words from the book; predict the winner of a school election based on randomly sampled survey data. Gauge how far off the estimate or prediction might be.*	**7.SP.2** Students collect and use multiple samples of data to answer question(s) about a population. Issues of variation in the samples should be addressed.

Statistics and Probability	**7.SP**
Common Core Cluster	
Draw informal comparative inferences about two populations.	
Common Core Standard	**Unpacking** What does this standard mean that a student will know and be able to do?
7.SP.3 Informally assess the degree of visual overlap of two numerical data distributions with similar variabilities, measuring the difference between the centers by expressing it as a multiple of a measure of variability. *For example, the mean height of players on the basketball team is 10 cm greater than the mean height of players on the soccer team, about twice the variability (mean absolute*	**7.SP.3** This is the students' first experience with comparing two data sets. Students build on their understanding of graphs, mean, median, Mean Absolute Deviation (M.A.D.) and interquartile range from 6th grade. Students understand that 1. a full understanding of the data requires consideration of the measures of variability as well as mean or median, 2. variability is responsible for the overlap of two data sets and that an increase in variability can increase the overlap, and 3. median is paired with the interquartile range and mean is paired with the mean absolute deviation .

deviation) on either team; on a dot plot, the separation between the two distributions of heights is noticeable.	
7.SP.4 Use measures of center and measures of variability for numerical data from random samples to draw informal comparative inferences about two populations. *For example, decide whether the words in a chapter of a seventh-grade science book are generally longer than the words in a chapter of a fourth-grade science book.*	**7.SP.4** Students are expected to compare two sets of data using measures of center and variability.

Common Core Cluster

Investigate chance processes and develop, use, and evaluate probability models.

Common Core Standard	Unpacking What does this standard mean that a student will know and be able to do?
7.SP.5 Understand that the probability of a chance event is a number between 0 and 1 that expresses the likelihood of the event occurring. Larger numbers indicate greater likelihood. A probability near 0 indicates an unlikely event, a probability around ½ indicates an event that is neither unlikely nor likely, and a probability near 1 indicates a likely event.	**7.SP.5** This is students' first formal introduction to probability. Students recognize that all probabilities are between 0 and 1, inclusive, the sum of all possible outcomes is 1. For example, there are three choices of jellybeans – grape, cherry and orange. If the probability of getting a grape is $\frac{3}{10}$ and the probability of getting cherry is $\frac{1}{5}$, what is the probability of getting oranges? The probability of any single event can be recognized as a fraction. The closer the fraction is to 1, the greater the probability the event will occur. Larger numbers indicate greater likelihood. For example, if you have 10 oranges and 3 apples, you have a greater likelihood of getting an orange.
7.SP.6 Approximate the probability of a chance event by collecting data on the chance process that produces it and observing its long-run relative frequency, and predict the approximate relative frequency given the probability. *For example, when rolling a number cube 600 times, predict that a 3 or 6 would be rolled roughly 200 times, but probably not exactly 200 times.*	**7.SP.6** Students collect data from a probability experiment, recognizing that as the number of trials increase, the experimental probability approaches the theoretical probability. The focus of this standard is relative frequency -- The relative frequency is the observed number of successful events for a finite sample of trials. Relative frequency is the observed proportion of successful events.
7.SP.7 Develop a probability model and use it to find probabilities of events. Compare probabilities from a model to observed frequencies; if the agreement is not good, explain possible sources of the discrepancy. a. Develop a uniform probability model by assigning equal	**7.SP.7** Probabilities are useful for predicting what will happen over the long run. Using theoretical probability, students predict frequencies of outcomes. Students recognize an appropriate design to conduct an experiment with simple probability events, understanding that the experimental data give realistic estimates of the probability of an event but are affected by sample size.

probability to all outcomes, and use the model to determine probabilities of events. *For example, if a student is selected at random from a class, find the probability that Jane will be selected and the probability that a girl will be selected.* b. Develop a probability model (which may not be uniform) by observing frequencies in data generated from a chance process. *For example, find the approximate probability that a spinning penny will land heads up or that a tossed paper cup will land open-end down. Do the outcomes for the spinning penny appear to be equally likely based on the observed frequencies?*	
7.SP.8 Find probabilities of compound events using organized lists, tables, tree diagrams, and simulation. a. Understand that, just as with simple events, the probability of a compound event is the fraction of outcomes in the sample space for which the compound event occurs. b. Represent for compound events using methods such as organized lists, tables and tree diagrams. For an event described in everyday language (e.g., "rolling double sixes"), identify the outcomes in the sample space which compose the event.	**7.SP.8** Students use tree diagrams, frequency tables, and organized lists, and simulations to determine the probability of compound events. Probabilities are useful for predicting what will happen over the long run. Using theoretical probability, students predict frequencies of outcomes. Students recognize an appropriate design to conduct an experiment with simple probability events, understanding that the experimental data give realistic estimates of the probability of an event but are affected by sample size.

c. Design and use a simulation to generate frequencies for compound events. For example, use random digits as a simulation tool to approximate the answer to the question: If 40% of donors have type A blood, what is the probability that it will take at least 4 donors to find one with type A blood?	